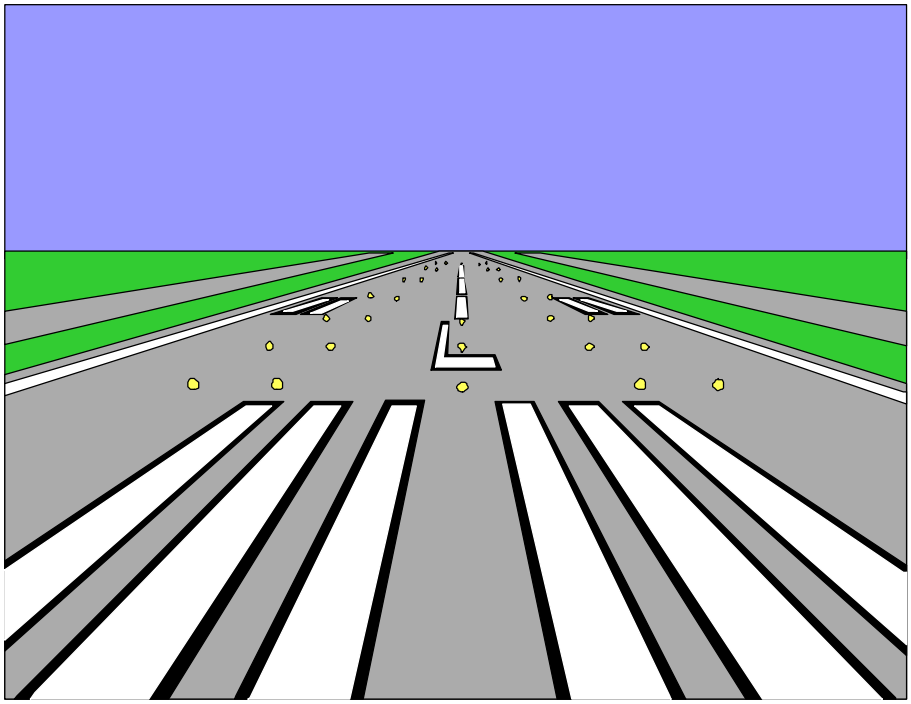
U.S. Department of Transportation
Federal Aviation Administration

REPORT TO CONGRESS

NATIONAL PLAN OF INTEGRATED AIRPORT SYSTEMS (1998-2002)



Washington, DC

MARCH 1999

REPORT OF THE SECRETARY OF TRANSPORTATION TO THE UNITED STATES CONGRESS PURSUANT TO SECTION 47103 OF TITLE 49, UNITED STATES CODE

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EXECUTIVE SUMMARY

The National Plan of Integrated Airport Systems (NPIAS) is submitted to Congress in accordance with Section 47103 of Title 49 of United States Code. The plan identifies 3,344 existing airports that are significant to national air transportation and contains estimates that $35.1 billion in infrastructure development that is eligible for Federal aid will be needed over the next 5 years to meet the needs of all segments of civil aviation.

The NPIAS includes a section on the condition and performance of the airport system, highlighting six topics: safety, capacity, pavement condition, financial performance, accessibility, and noise. The findings are generally favorable, indicating that the system is safe, convenient, well maintained, and largely supported by rents, fees, and taxes paid by users. Problems are apparent in specific areas, with a large number of people exposed to high noise levels and delays due to airfield and ground access congestion at some of the busiest airports.

The noise situation is improving due to industry and Government efforts to replace noisy aircraft and obtain a quieter aircraft fleet. As of December 31, 1997, quieter Stage 3 airplanes constituted 79.8 percent of the air carrier aircraft operating at U.S. airports. Further improvements will be made, and the population exposed to significant noise levels is expected to decline from 1.7 million in 1995 to 600,000 by the turn of the century.

The trend toward greater air traffic delays was temporarily arrested from 1991 through 1995, in part through measures like the construction of new runways and more efficient use of existing capacity. However, in 1996, air traffic delays rose again, apparently due to the introduction of new separation standards which increased the distance between certain types of aircraft. A more gradual increase in delays is expected in the future, and major airfield improvements together with enhanced technology are planned to help mitigate those delays.

Most citizens have excellent access to air transportation, with 98 percent of the population living within 20 miles of a NPIAS airport. The primary mode for ground access is by highway, but congestion and concern about air quality are stimulating interest in improved public transportation to airports in urban areas. The FAA, in cooperation with the Federal Highway Administration and other modal agencies, issued an airport access planning guide in December 1996. The guide will help airport operators and transportation planners achieve efficient access systems.

The cost estimates of future airport development included in this report are 18 percent higher than the preceding report, issued in 1995. This increase is largely due to an increase in airport development programs at large hub airports with terminal and access development accounting for almost 50 percent of the development at large hub airports.

The cost estimates were obtained primarily from airport master and system plans that were prepared by planning and engineering firms for state and local agencies. Although these plans are not yet subject to uniform benefit/cost analysis, they are usually funded in part by the FAA, are consistent with FAA forecasts of aeronautical activity, follow FAA guidelines, and have been reviewed and accepted by FAA planners who are familiar with local conditions. Efforts have been made to obtain a realistic estimate of development needs that coincides with local and state capital improvement plans**.** The NPIAS is drawn from approved plans and may not include some emerging requirements, such as new large aircraft and enhanced security measures. The NPIAS only includes development to be undertaken by airport sponsors and does not include improvements to air traffic control and navigation and approach aids that are funded entirely by the FAA. Because the NPIAS is an aggregation of airport capital projects identified through the local planning process, rather than a spending plan, no attempt is made to prioritize the development projects that comprise the database or evaluate whether the benefits of specific development projects would exceed the costs.

Airports with significant commercial service account for 82 percent of the $35.1 billion total development; reliever airports serving general aviation in metropolitan areas account for 7 percent; and general aviation airports account for 11 percent.

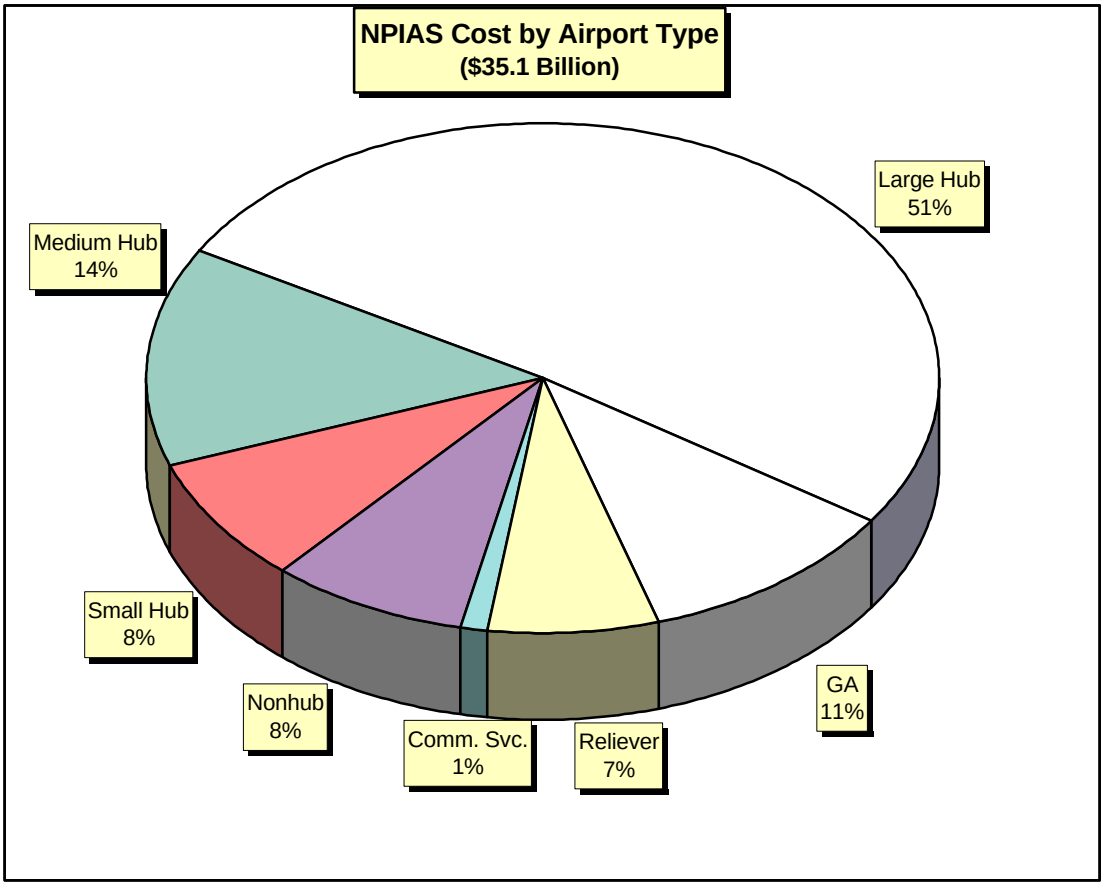

Figure 1 NPIAS Cost by Airport Type

The purpose of NPIAS development is primarily to bring existing airports up to current design standards and add capacity to congested airports. A significant amount (16 percent) is for the development of passenger terminal buildings. This is an increasingly important area of investment, as terminals are modified, expanded, and replaced to accommodate more passengers and larger aircraft.

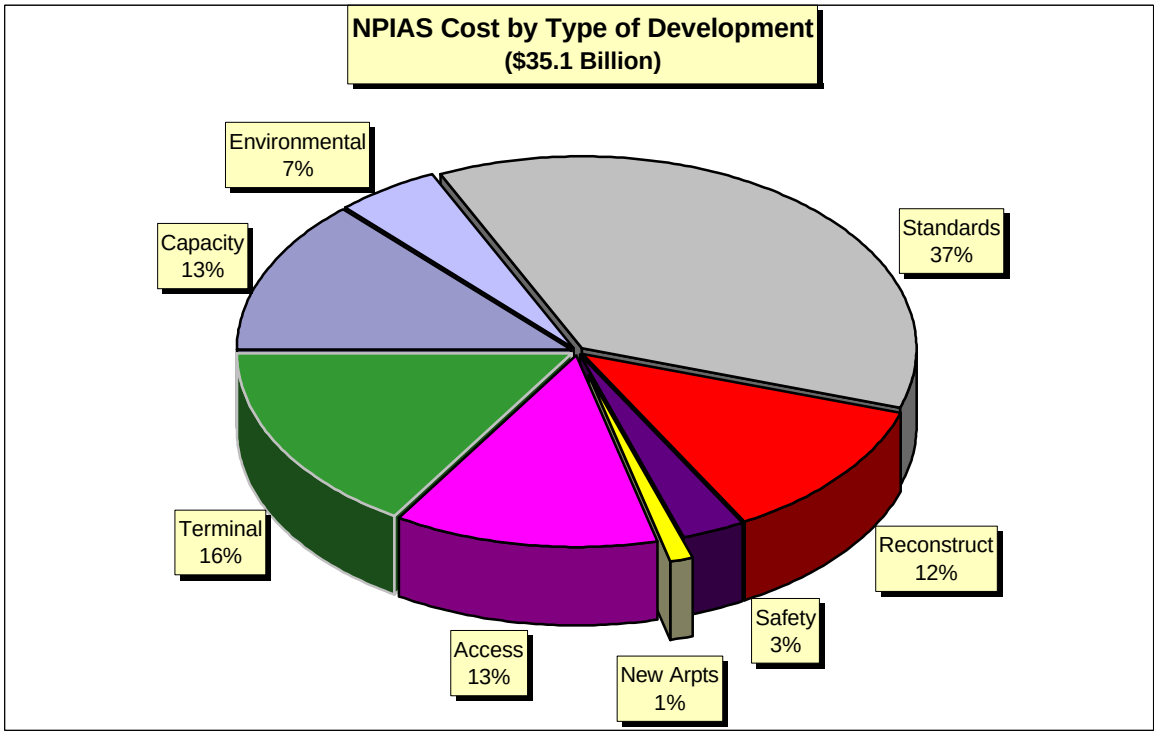

Figure 2 NPIAS Cost by Type of Development

The NPIAS only includes development that is eligible to receive Federal grants under the Airport Improvement Program. Funds for airport development may be derived from a variety of sources, including airport cash flow, bonds, Federal/state/local grants, and passenger facility charges**.** The combination of funding sources and their adequacy varies with type of airport and level of activity.

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CHAPTER 1

SYSTEM COMPOSITION

OVERVIEW

The United States accounts for approximately 40 percent of all commercial aviation and 50 percent of all general aviation activity in the world. An extensive system of airports has been developed to support this activity. A primary purpose of the NPIAS is to identify the airports that are important to national transportation and**,** therefore**,** eligible to receive grants under the Airport Improvement Program (AIP). The NPIAS is composed of all commercial service airports, all reliever airports, and selected general aviation airports. The word "airport" includes landing areas developed specifically for helicopters and seaplanes as well as conventional fixed wing aircraft landing areas.

U.S. DEPARTMENT OF TRANSPORTATION

The mission of the Department of Transportation is to serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

Toward this end, the Department has five strategic goals:

1. *Safety:* Promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage.

2. *Mobility:* Shape America's future by ensuring a transportation system that is accessible, integrated and efficient, and offers flexibility of choices.

3. *Economic Growth and Trade:* Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.

4. *Human and Natural Environment:* Protect and enhance communities and the natural environment affected by transportation.

5. *National Security:* Advance the Nation's vital security interests in support of national strategies, such as the National Security Strategy and National Drug Control Strategy, by ensuring that the transportation system is secure and available for defense mobility and that our borders are safe from illegal intrusion.

GUIDING PRINCIPLES FOR THE NATIONAL AIRPORT SYSTEM

The airport system was envisioned more than 50 years ago, when civil aviation was in its infancy, and it has been developed and nurtured by close cooperation among Federal, state, and local agencies. The general principles guiding Federal involvement have remained unchanged; the airport system should have the following attributes to meet the demand for air transportation:

- Airports should be safe and efficient; located at optimum sites; and developed and maintained to appropriate standards.
- Airports should be affordable to both users and Government, relying primarily on user fees and placing minimal burden on the general revenues of local, state, and Federal Government.
- Airports should be flexible and expandable, able to meet increased demand and to accommodate new aircraft types.
- Airports should be permanent, with assurance that they will remain open for aeronautical use over the long term.
- Airports should be compatible with surrounding communities, maintaining a balance between the needs of aviation and the requirements of residents of neighboring areas.
- Airports should be developed in concert with improvements to the air traffic control system.
- The airport system should support national objectives for defense, emergency readiness, and postal delivery.
- The airport system should be extensive, providing as many people as possible with convenient access to air transportation, typically not more than 20 miles travel to the nearest NPIAS airport.
- The airport system should help air transportation contribute to a productive national economy and international competitiveness.

In addition to these guiding principles, specific to airport development, a guiding principle for Federal infrastructure investment in general, as stated in Executive Order 12893, is that such investments must be cost beneficial. The FAA implements these principles by using program guidance to ensure the effective use of Federal aid. A national priority system guides the distribution of funds, supplemented when necessary by specific requirements for additional analysis or justification. For example, airport capacity development projects must be shown to be cost beneficial to receive major support under the Airport Improvement Program.

COMMERCIAL SERVICE AIRPORTS

Commercial service airports are defined as public airports receiving scheduled passenger service and having 2,500 or more enplaned passengers per year. There are 540 commercial service airports. Of these, 413 have more than 10,000 enplanements and are classified as primary airports.

Primary airports receive an annual apportionment of at least $500,000 in AIP funds, with the amount determined by the number of enplaned passengers.

LARGE HUBS

The term "hub" is used by the FAA to identify very busy commercial service airports. For instance, large hubs are those airports that account for at least 1 percent of total U.S. passenger enplanements. Some enplanements originate in the local community and some consist of en route passengers transferring from one flight to another. Several large hub airports have very little passenger transfer activity (LaGuardia, Ronald Reagan Washington National, and San Diego International, for example), while transfers account for more than half of the traffic at others (Atlanta, Pittsburgh, and St. Louis, for example). Together the 29 large hub airports account for 67 percent of all passenger enplanements. Large hub airports tend to concentrate on airline passenger and freight operations and have limited general aviation activity. Five large hub airports (Salt Lake City, Las Vegas, Honolulu, Miami, and Phoenix) have an average of 343 based aircraft, but the other 24 large hubs average only 34 based aircraft each. Thus, locally based general aviation plays a relatively small role at most large hubs.

The Nation's air traffic delay problems are concentrated at 29 large hub airports where the average delay per aircraft operation was 5.3 minutes in 1997. Delays occur primarily during instrument weather conditions when runway capacity is reduced below that needed to accommodate airline schedules.

MEDIUM HUBS

Medium hubs are defined as airports that account for between 0.25 percent and 1 percent of the total passenger enplanements. There are 42 medium hub airports, and together they account for 22 percent of all enplanements. Medium hub airports usually have sufficient capacity to accommodate air carrier operations and a substantial amount of general aviation. Medium hub airports have an average of 173 based aircraft. The delay per operation averaged 2.6 minutes for the 42 medium hub airports in 1997.

SMALL HUBS

Small hubs are defined as airports that enplane 0.05 percent to 0.25 percent of the total passenger enplanements. There are 70 small hub airports that together account for 7 percent of all enplanements. Less than 25 percent of the runway capacity at small hub airports is used by airline operations, so these airports can accommodate a great deal of general aviation activity, with an average of 130 based aircraft. These airports are typically uncongested and do not account for significant air traffic delays.

Distribution of Activity

Number Airports	Airport Type	Percentage of All Enplanements	Percentage of Active GA Aircraft[1]
29	Large-Hub Primary	67.3	1.3
42	Medium-Hub Primary	22.2	3.8
70	Small-Hub Primary	7.1	4.7
272	Nonhub Primary	3.3	11.4
125	Other Commercial Service	0.1	2.1
334	Relievers	0.0	31.5
2,472	General Aviation	0.0	37.3
3,344	Existing NPIAS Airports	100.0	92.1
15,000	Low Activity Landing Areas (Non-NPIAS)	0.0	7.9

Table 1 Distribution of Activity

NONHUB PRIMARY

Commercial service airports that enplane less than 0.05 percent of all commercial passenger enplanements but more than 10,000 annually are categorized as nonhub primary airports. There are 272 nonhub primary airports that together account for 3 percent of all enplanements. These airports are heavily used by general aviation aircraft, with an average of 81 based aircraft.

[1] Based on an estimated aircraft fleet of 191,562 aircraft.

OTHER COMMERCIAL SERVICE

Commercial service airports enplaning 2,500 to 10,000 passengers annually are categorized as other commercial service airports. There are 125 of these airports in the NPIAS, and they account for .1 percent of all enplanements. These airports are used mainly by general aviation and have an average of 33 based aircraft.

RELIEVER AIRPORTS

General aviation pilots often find it difficult and expensive to gain access to congested airports, particularly large and medium hub airports. In recognition of this, the FAA has encouraged the development of high capacity general aviation airports in major metropolitan areas. These specialized airports, called relievers, provide pilots with attractive alternatives to using congested hub airports. They also provide general aviation access to the surrounding area. The 334 reliever airports have an average of 181 based aircraft, and together account for 32 percent of the Nation's general aviation fleet. All of the airports that are designated as relievers by the FAA are included in the NPIAS.

GENERAL AVIATION AIRPORTS

Communities that do not receive scheduled commercial service may be included in the NPIAS as sites for general aviation airports if they account for enough activity (usually at least 10 locally owned aircraft) and are at least 20 miles from the nearest NPIAS airport. The activity criterion may be relaxed for remote locations or other mitigating circumstances. The 2,472 general aviation airports in the NPIAS tend to be distributed on a one-per-county basis in rural areas and are often located near the county seat. These airports, with an average of 29 based aircraft, account for 37 percent of the Nation's general aviation fleet. These airports are the most convenient source of air transportation for about 19 percent of the population and are particularly important to rural areas.

AIRPORTS NOT INCLUDED IN NPIAS

The NPIAS includes 3,344 of the 5,357 airports open to the public (Figure 3). There are over 2,000 airports open to the public that are not included in the NPIAS. Approximately 1,000 publicly owned, public use airports are not included because they do not meet the minimum entry criteria of 10 based aircraft, are within 20 miles of a NPIAS airport, or are located at inadequate sites and cannot be expanded and improved to provide safe and efficient airport facilities. The FAA usually recommends replacement of inadequate airports. The remaining 1,000 are privately owned, public use airports that are not included because they are located at inadequate sites, are redundant to publicly owned airports, or have too little activity to qualify for inclusion. In addition, more than 12,000 civil landing areas that are not open to the general public are not included in the NPIAS. The airports that are not included in the NPIAS have an average of less than 2 based aircraft, compared to 53 based aircraft at the average NPIAS airport.

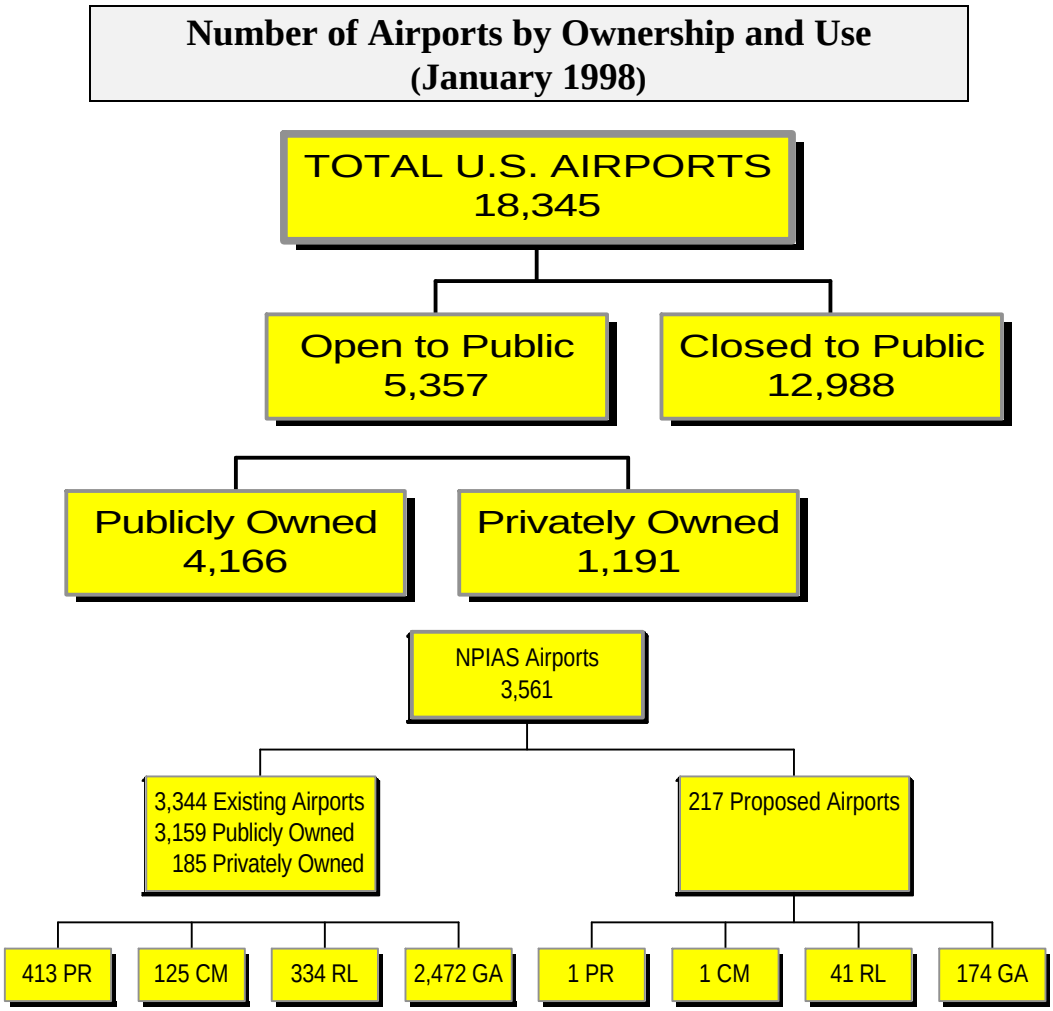
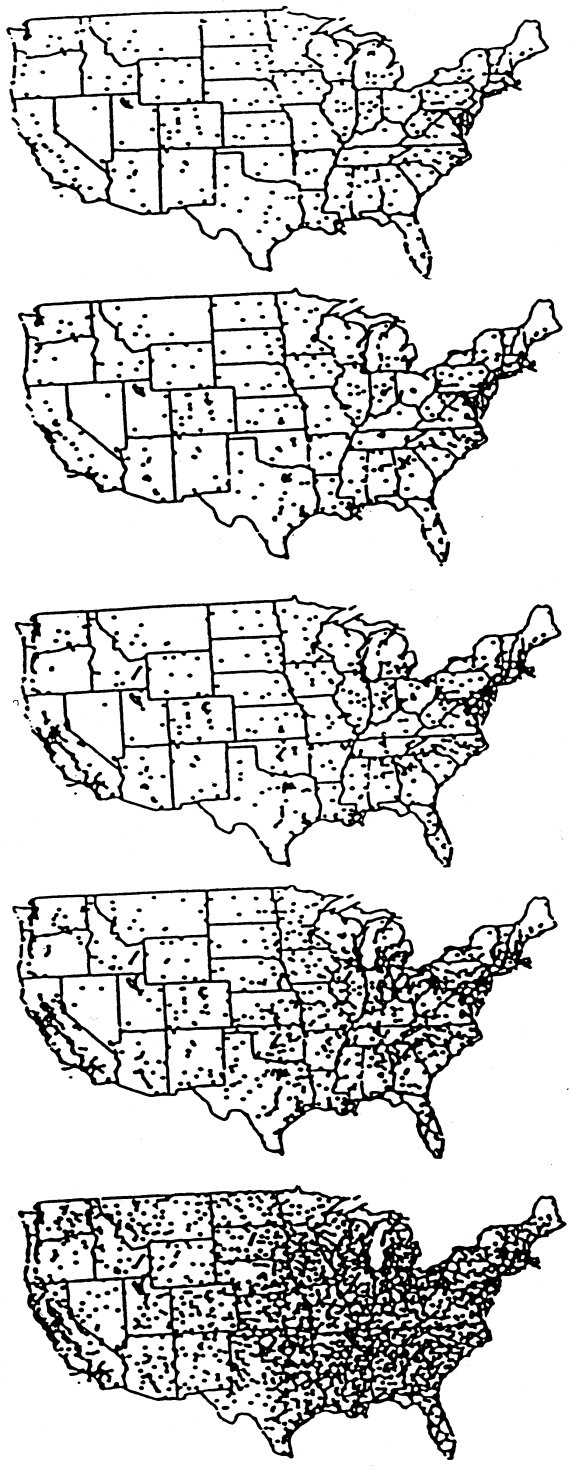


Figure 3 Number of Airports by Ownership

STATE PLANS INCLUDE MORE AIRPORTS

Each state has an airport system plan that identifies the location and scale of development that is considered necessary to satisfy the state's need for air transportation. The state plans contain a total of more than 6,000 airports, about 84 percent more than the NPIAS. The airports that are included in state plans but not in the NPIAS are usually small airports that have local significance but are not considered to have national significance.

Geographic Coverage [1]



1 538 Airports – commercial service account for:
100% of enplanements
23% of general aviation aircraft
82% of NPIAS cost
70% of the population resides within 20 miles of these airports

2. 872 Airports – 538 commercial service and 334 relievers account for:
100% of enplanements
54% of general aviation aircraft
89% of NPIAS cost
79% of the population resides within 20 miles of these airports

3. 1,261 Airports – 538 commercial service, 334 relievers, and 389 general aviation airports with over 50 aircraft account for:
100% of enplanements
74% of general aviation aircraft
90% of NPIAS cost
85% of the population resides within 20 miles of these airports

4. 1,812 Airports – 538 commercial service, 334 relievers, and 940 general aviation airports with over 25 aircraft account for:
100% of enplanements
84% of general aviation aircraft
94% of NPIAS cost
85% of the population resides within 20 miles of these airports

5. 3,344 NPIAS Airports – commercial service, relievers, and general aviation airports account for:
100% of enplanements
92% of general aviation aircraft
100% of NPIAS cost
98% of the population resides within 20 miles of these airports

Figure 4 Geographic Coverage

[1] Alaska and Hawaii are included in the statistics shown above.

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CHAPTER 2

CONDITION AND PERFORMANCE

OVERVIEW

The Federal role in airport development is largely related to optimizing system performance. The primary purpose of this chapter is to describe how well the airport system is operating and to highlight any trends that are apparent. Six key factors have been selected to gauge the level of system performance: capacity, safety, noise, pavement condition, accessibility, and financial performance.

APPLICATION

Each of the six factors is relevant to the quality of air transportation and, taken together, they provide a good overview of system performance. However, the six factors are not equally sensitive to capital improvements, and increased investment is not necessarily the most effective way to improve performance.

For instance, airport investment is only one of a variety of measures that must be combined to reduce the already low rate of accidents. Communications, navigation and surveillance systems, airport inspection, pilot training, avionics, human factors, and aircraft and engine technology also contribute to the gradual improvement of aviation safety. Federal aid to airports can be particularly useful in focusing on specific issues, such as the implementation of security measures, provision of rescue equipment, development of safety areas around runways, and removal of obstructions in runway approach zones.

The principal factor in reducing the number of people exposed to high noise levels is the expanded use of quieter aircraft and the Federal Government has actively encouraged new technology in this area. However, Federal aid is very useful in addressing hard-core problems that would otherwise persist despite the use of quieter aircraft. Federal aid for planning and implementing noise abatement measures has fostered a more cooperative relationship between airports and surrounding communities, helping to relieve a serious and complex societal issue.

A section on monitoring the performance of terminal buildings will be added to future reports, if and when a suitable technique is developed. A report is not possible at this time because there is no consensus about which aspects to measure and how to measure them.

CAPACITY

The performance of the airport system is affected by many factors, including the layout of individual airports, the manner in which airspace is organized and used, operating procedures, and application of technology.

A major concern in airport system planning is the adequacy of runways to handle anticipated aircraft operations. If air traffic demand exceeds runway capacity, air traffic is delayed, causing expense to airlines, inconvenience to passengers, and increased workload for the FAA air traffic control system.

Most airports are uncongested because they serve small communities and a single runway is able to handle over 200,000 operations annually, which is approximately the amount of activity that would be generated by a city with 350,000 inhabitants. More runways are one means to provide more capacity. Other means are described in the section of this report on noncapital alternatives. As traffic increases, it can also be divided among airports within a system. Reliever airports are developed to serve general aviation, allowing commercial service airports to concentrate on air carrier operations.

When a city becomes so large that it generates more than 10 to 12 million originating passengers per year, a second commercial service airport may be warranted. There are few cities this large: London, Paris, and Tokyo fit the example, as well as New York, Los Angeles, San Francisco, Chicago, Miami, and Washington in the United States.

The concentration of traffic at an airport can result in congestion and delay. Delay is defined as the difference between the time an operation actually takes and the time that it would have taken under uncongested conditions without interference from other aircraft. Delay is reported in a number of ways. Air traffic controllers identify instances where aircraft are delayed 15 minutes or more in a given flight segment, and this information is used by the FAA to monitor the day-to-day operation of the air traffic control system. The number of airline arrivals and departures that are delayed 15 minutes or more is compiled by the Department of Transportation for busy airports and is reported regularly as information for consumers. Airport planners and designers use the average delay per aircraft operation as a measure of congestion. This measure is directly related to demand and capacity, it can be forecast, and it can be translated into a dollar cost of delay.

Experience shows that delay increases gradually with rising levels of traffic until the practical capacity of an airport is reached, at which point the average delay per aircraft operation is in the range of 3 to 5 minutes. Delays increase rapidly once traffic demand increases beyond this level. An airport is considered to be congested when average delay exceeds 5 minutes per operation. Beyond this point delays are extremely volatile, and a small increase in traffic, adverse weather conditions, or other disruptions can result in lengthy delays that upset flight schedules and impose a heavy workload on the air traffic control system.

There were 13 airports with average delay in excess of 5 minutes per operation that accounted for most of the severe air traffic delays in the United States during 1997.

Airports with Average Delay In Excess of 5 Minutes Per Operation In 1997

✈ Newark International
✈ Atlanta Hartsfield
✈ LaGuardia
✈ Philadelphia International
✈ Dallas-Fort Worth International
✈ Detroit Metropolitan
✈ St. Louis International
✈ Minneapolis-Saint Paul International
✈ John F. Kennedy International
✈ Boston Logan
✈ Cincinnati-Hopkins International
✈ Chicago O'Hare International
✈ San Francisco International

Table 2 Congested Airports

The trend toward greater air traffic delays was temporarily arrested from 1991 through 1995, in part through measures like the construction of new runways and more efficient use of existing capacity. However, in 1996, air traffic delays rose again, apparently due to the introduction of new separation standards which increased the distance between certain types of aircraft. A more gradual increase in delays is expected in the future, and major airfield improvements together with enhanced technology are planned to help mitigate those delays.

ALTERNATIVE MEASURES

The construction of new runways is not the only response to airfield congestion. The continued application of certain measures, termed alternative measures, will help to limit delay without substantial investment.

Delays can be reduced, in part, by modifying air traffic control procedures to improve the flow of aircraft en route and in the terminal area. The FAA is developing more flexible en route procedures. Long-term goals for operational procedures focus on free flight, in which air traffic controllers will intervene only to prevent conflicts. The FAA is

developing new instrument approach procedures that will enhance runway capacity during adverse weather. A new safety and capacity program is expected to facilitate aircraft taxiing in very low visibility weather conditions.

Over the next two decades, the FAA expects additional enhancements due to advances in technology related to automation; information systems; communications, navigation, and surveillance; and weather.

Redistribution of traffic among airports to make more efficient use of facilities is another measure that can be used to reduce delays. Reliever airports have been developed in metropolitan areas to give general aviation pilots an attractive alternative to using congested commercial service airports. Large cities usually have a system of reliever airports, one or more of which can accommodate corporate jet aircraft and others designed exclusively for use by smaller, propeller-driven aircraft. Relievers have been very successful at relocating general aviation activity from congested airports. As a result, general aviation activity at congested airports is a small percentage of total operations (3.9 percent of the operations at O'Hare, 2.9 percent of the operations at Atlanta Hartsfield, and 5.8 percent of the operations at LaGuardia Airport) while general aviation activity at all other airports with airport traffic control towers accounts for nearly 60 percent of the operations. Thirty-one percent of the general aviation aircraft in the United States are based at the 334 reliever airports.

The concept of relocating passenger transfer operations from congested hub airports in Chicago, Atlanta, Dallas, and other metropolitan areas to remote airports has also been considered. However, it appears that passenger transfer operations are most efficiently located at airports that generate a considerable amount of origin and destination traffic, and this only occurs in or near metropolitan areas. The FAA has discussed this subject with representatives of several major airlines and has concluded that they will continue to locate their hub operations as close as possible to large population centers rather than in rural, sparsely populated areas.

Airline scheduling practices tend to limit the level to which delays are likely to rise, particularly at transfer hub airports. Air carriers are willing to tolerate a certain amount of congestion, but when delays become excessive and the reliability of connections declines, carriers are likely to consolidate schedules and may relocate some operations to other airports. The level of congestion at hub airports is often determined primarily by the dominant airline. In 1998 the Department of Transportation began a study of how airport practices affect competition among air carriers. A major focus of the study is to examine airport operations and airline competition at congested hub airports. The purpose of the study is to give departmental officials a better understanding of these issues.

Another factor that helps to limit delay is the ability of carriers to introduce service to outlying, suburban airports, using them to relieve congestion at the principal airport.

A measure that provided great increases in runway efficiency in the past was the use of larger aircraft, particularly at congested airports, in order to move more passengers per operation. Between 1972 and 1995, there was a 114-percent increase in the average number of passengers per aircraft operation nationwide, and a 92-percent increase at large hub airports (Table 3). Greater use of aircraft with increased size and weight may be limited by the design of many airports. The distance between adjacent taxiways and runways and the layout of terminal buildings can limit wingspans and fuselage lengths, and the strength of pavement and underlying structures, such as bridges and culverts, may limit aircraft weight. Because of these factors, future increases in aircraft size may be more gradual and more expensive to accommodate, particularly at older and more congested airports.

Activity at Large Hub Airports

Calendar Year	Enplaned Passengers	Air Carrier Departures	Large Hubs - Passengers/ Departure	National Average - Passengers/ Departure
1972	124,497,086	2,581,972	48.2	38.0
1975	131,277,693	2,472,756	53.1	42.5
1980	197,679,376	2,887,239	68.5	55.7
1985	264,507,144	3,439,446	76.9	66.9
1990	325,150,414	3,887,651	83.7	72.0
1995	393,110,251	4,245,508	92.6	81.2
1997	439,556,180	4,540,627	96.8	85.6

Table 3 Activity at Large Hub Airports

Another measure is the redistribution of traffic to smooth out peaks that occur because of traveler preferences for morning and evening flights. Schedules tend to peak sharply at an uncongested airport, but this is reduced as traffic increases and more frequent service fills in the non-peak hours. A few very busy airports have about the same number of flights scheduled during each of the daylight and evening hours.

Peak and off-peak pricing could be used to redistribute some portion of the peak traffic loads that occur because of travelers' preference for morning and evening flights. While it is not practical to expect to eliminate peaking entirely, certain busy airports might reduce delays and improve efficiency by applying properly structured peak pricing, which is not unjustly discriminatory and provides an economic incentive for the users of the airport to spread demand more evenly over the airport's normal operating hours. Congestion pricing is not a substitute for necessary airport capacity improvements, but in certain cases it might encourage more efficient use of existing airport capacity.

SAFETY

The operators of public airports maintain a high level of safety by selecting the best available sites, designing airfields to high standards, and applying appropriate operating and maintenance procedures. The cause of most accidents on or near airports is attributable to pilot error, such as failure to perform adequate preflight preparation and inspection of aircraft, or failure to achieve and maintain adequate airspeed. Airports, occasionally, are cited as a contributing factor in accidents. When they are, it is often in conjunction with weather conditions, such as when snow, ice, or water is on the runway. These factors are being alleviated by pavement surface treatments to enhance friction and improve aircraft braking performance, by the acquisition of snow removal equipment, and by emphasis on measures to detect and correct slippery runway conditions.

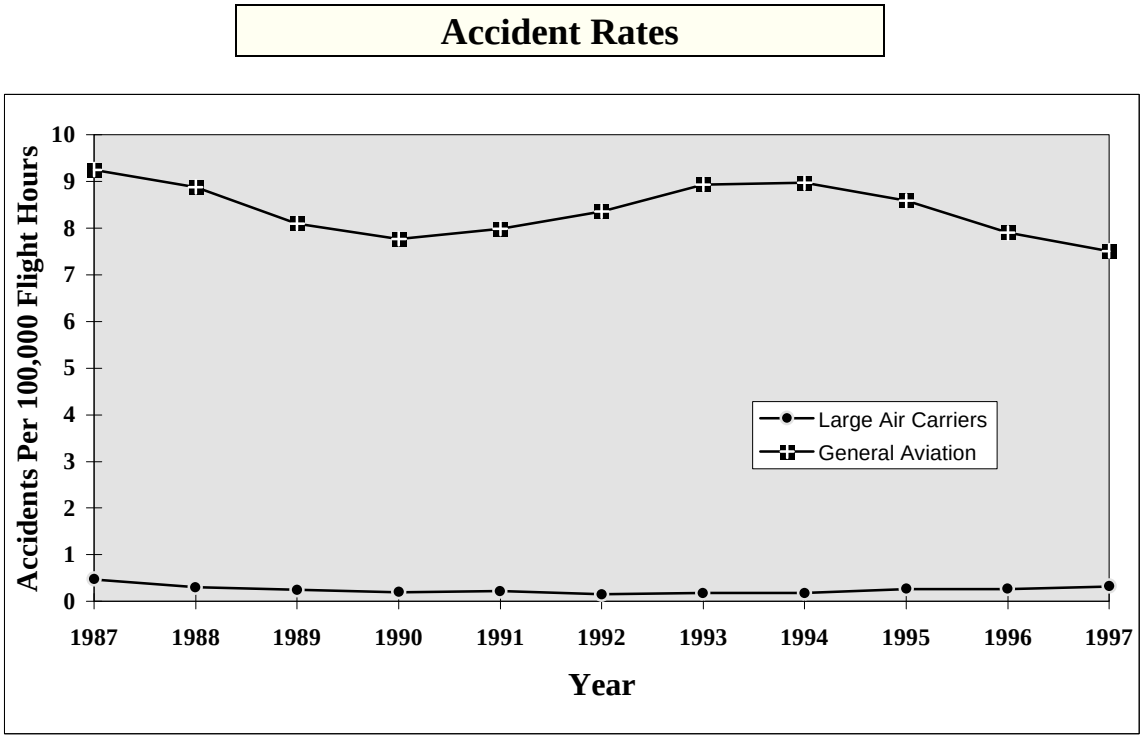


Figure 5 Accident Rates

Since so few accidents are attributable to airport deficiencies, it has not been possible to develop a statistically significant relationship between safety and capital investment in airports. However, the success of airports in not becoming a link in the chain of events or circumstances that lead to an accident can be attributed to their adherence to Federal standards for design and operation. These standards, which have been developed over time, provide the necessary dimensions or procedures to accommodate aircraft operations along with an extra margin of safety to accommodate deviations from the norm.

For example, the standards for runway safety areas are designed to minimize damage to aircraft and injuries to occupants when an aircraft unintentionally leaves the runway. The standards provide for graded areas contiguous to the runway edges that are free of ruts, humps, and other surface irregularities. In addition, only objects that have to be in the safety area because of their function, such as runway lights or signs, should be in the safety area and they should be mounted so that they break away if struck by an aircraft. The consequences of incidents are less likely to be severe because of the measures that are part of the design standards.

Airport operators who undertake capital development with Federal funds are required to adhere to certain design standards. This results in uniformity from one airport to the next and helps promote safety by reinforcing pilot expectations. Uniformity is particularly important in the area of visual cues, such as marking, lighting, and signs.

Airports served by air carrier aircraft with a seating capacity of more than 30 passengers are subject to initial safety certification inspection by FAA credentialed inspectors and annual re-inspection to determine continued compliance with regulatory safety standards. These standards are contained in Part 139 of the Federal Aviation Regulations (FAR), Certification and Operations: Land Airports Serving Certain Air Carriers. There are approximately 575 certificated airports**.** In 1996, Congress provided the FAA with the authority to extend Part 139 certification requirements to airports served by commercial air carrier aircraft with a seating capacity of more than 9 passengers. A proposed rulemaking implementing this new authority is underway.

Part 139 establishes 18 general areas of safety standards, ranging from specific items, such as the condition of runway surfaces and training requirements for aircraft rescue and fire fighting personnel, to more general requirements for the development of an airport emergency plan and wildlife control plan. While all areas identified in Part 139 are inspected, special inspection initiatives may emphasize one or more aspects of Part 139. For instance, the FAA is very concerned about reducing unauthorized entry onto runways by aircraft or ground vehicles. A program was initiated in 1991, putting special emphasis on the adequacy of marking, lighting, and signage. The rate of reported runway incursions declined for several years after the program was initiated, but then began to increase (Figure 6). The FAA has established a runway incursion team to examine the issue further and develop measures to prevent runway incursions.

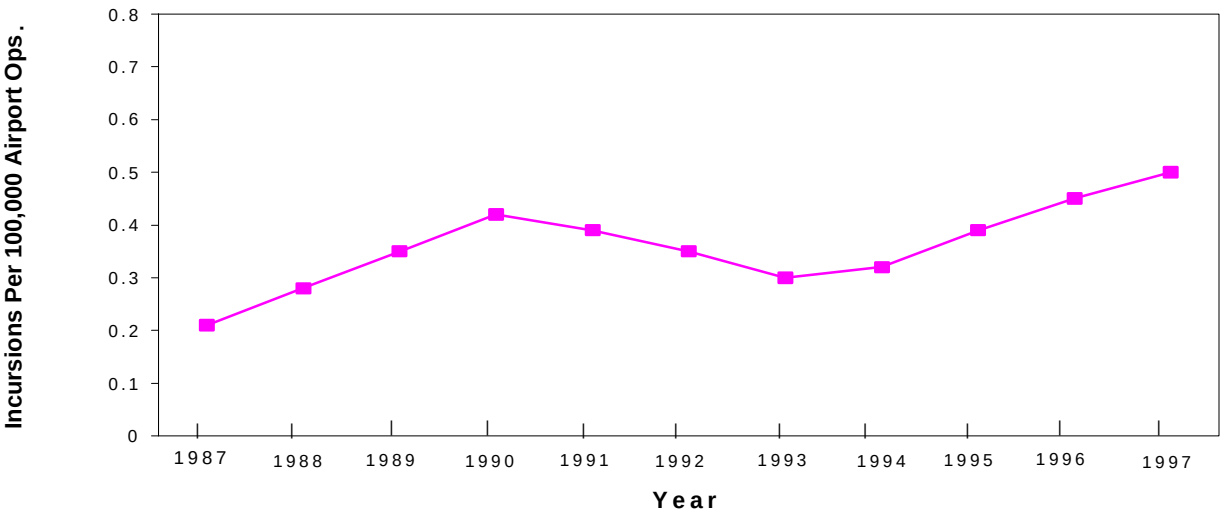


Figure 6 Runway Incursions

AIRCRAFT NOISE

Community concern about aircraft noise is a major constraint on the operation and expansion of existing airports and the development of new ones. The problem is particularly serious in metropolitan areas, where airports are heavily used and there is strong pressure to develop residential areas around them.

The Federal Government pursues a program of aircraft noise control in cooperation with the aviation community. Much of the program is aimed at reducing noise at the source, through the use of quieter engines. The FAA adopted Part 36 of the Federal Aviation Regulations in 1969, establishing noise certification standards for new design turbojet and transport category aircraft. In 1976, the Federal Aviation Regulations were amended, to allow U.S. operators until January 1, 1985**,** to quiet or retire the noisiest (Stage 1) aircraft.

In 1977**,** the regulations were again amended; defining three "stage" levels to categorize aircraft noise emissions and requiring aircraft certificated after March 3, 1977, to meet the more demanding Stage 3 requirement. The Airport Noise and Capacity Act of 1990 was then enacted, setting December 31, 1999, as the deadline for elimination of Stage 2

aircraft in the contiguous United States weighing more than 75,000 pounds. A schedule for compliance was established under Part 91 of the Federal Aviation Regulations.

Each domestic and foreign operator of large civil subsonic turbojet airplanes must submit an annual report reflecting compliance progress as of the end of the calendar year. The composite data derived from the 1997 operator reports show that the number of Stage 2 large civil subsonic turbojet airplanes operating in the contiguous United States continued to decline. As of December 31, 1997, domestic and foreign operators collectively reached a cumulative Stage 2 fleet reduction of 51.6 percent from the base level. As of December 31, 1997, Stage 3 airplanes constituted 79.8 percent of the combined domestic and foreign air operator fleets operating to and from U.S. airports, up from 45 percent in 1990.

A program to encourage noise reduction has supplemented the steady and substantial improvements in noise exposure due to quieter aircraft and compatible land uses in areas around airports. Part 150 of the Federal Aviation Regulations, adopted in January 1985, established a system for measuring aviation noise in the community and for providing information about land uses that are normally compatible with various levels of noise exposure. Part 150 encourages airport operators to develop Noise Exposure Maps and Noise Compatibility Programs. Noise Exposure Maps identify noise contours and land use incompatibilities and are useful in evaluating noise impacts and discouraging incompatible development. Once the FAA determines that Noise Exposure Maps have been prepared in accordance with Part 150, the airport operator may submit a Noise Compatibility Program, coordinated with affected parties, outlining measures to improve noise and land use compatibility.

Through fiscal year 1997, 235 airports were participating in the Part 150 program, 221 had Noise Exposure Maps in compliance with program requirements, and 191 had Airport Noise Compatibility Programs approved by FAA. An FAA-approved Noise Compatibility Program clears the way for an airport to obtain Federal aid for noise projects. Approximately $2.1 billion has been granted for airport noise compatibility projects since 1982.

The improvement in the noise situation around airports since 1975 has been dramatic, with the estimated population exposed to severe noise declining from 7 million persons to 1.7 million in 1995 (Figure 7). This improvement is remarkable because it took place during a period of substantial growth in air transportation, with enplanements more than doubling. It is projected that the population exposed to severe noise will continue to decline to 600,000 in the year 2000.

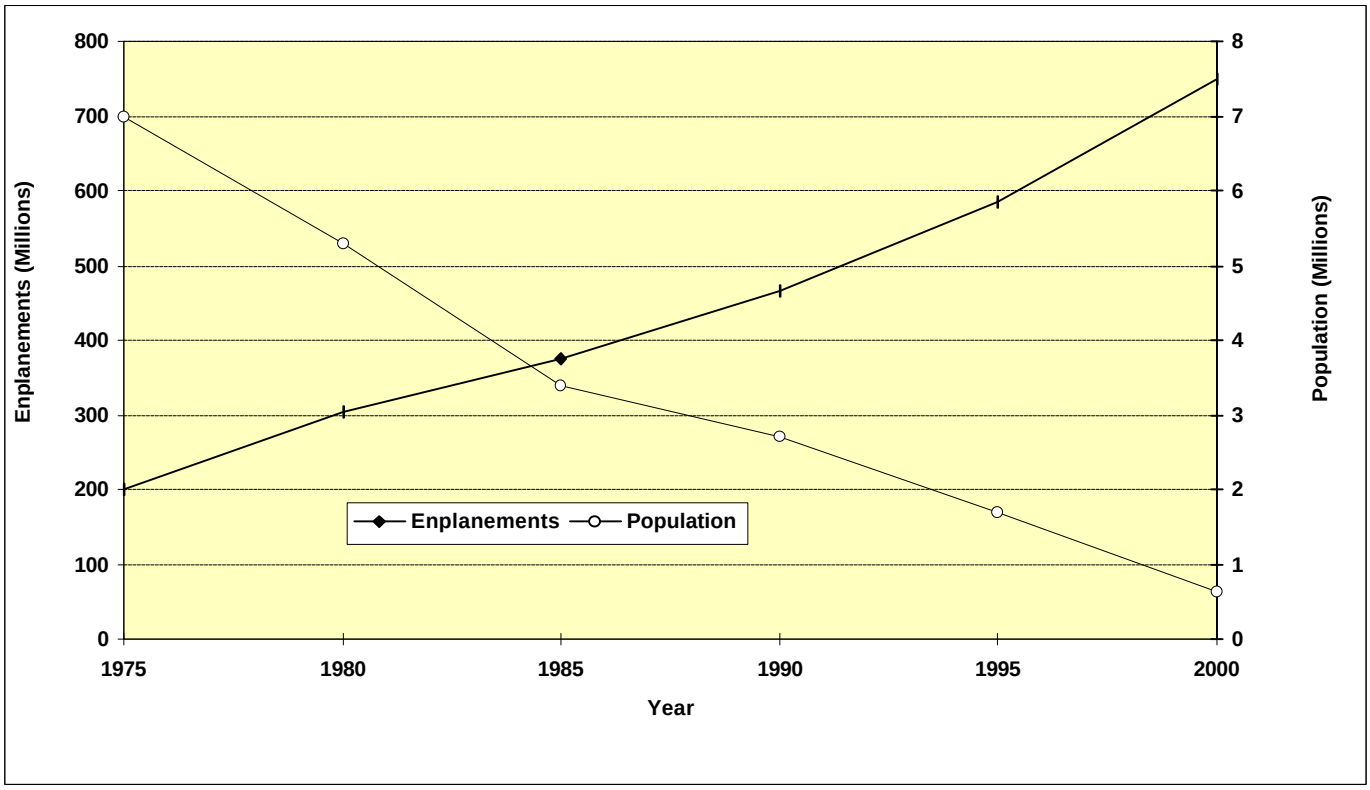


Figure 7 Population Exposed to High Noise Levels Compared to Enplanements

Despite the reduction in aircraft noise emissions, public concern and sensitivity is still very high. In recent years, complaints and organized opposition have come from populations exposed to comparatively low levels of noise, sometimes at locations miles from the nearest airport. This will be a factor in future planning for the airport and airspace system and will provide an impetus for further reductions in engine noise emissions.

PAVEMENT CONDITION

Airfield pavement needs regular maintenance to seal cracks and repair damage, and major rehabilitation is needed on a 15- to 20-year cycle to remedy the effects of age and exposure. If pavement is neglected, severe deterioration can cause damage to propellers, turbines, and aircraft landing gear.

In an effort to ensure that pavement receives the optimum level of maintenance, the FAA has been authorized by Congress to establish a pilot program permitting the use of AIP grants for routine pavement maintenance, normally ineligible, at nonprimary airports. The provision authorizes selection of not more than 10 such pilot projects, at least 2 of which must be within states having no medium or large hub airports. To date, the following six candidates have been selected for the program: States of New York (5 airports), Vermont (4 airports), Alabama (various airports), Louisiana (various airports), and Texas (various airports) and the Port of Portland, Oregon (reliever airports). Alabama, New Hampshire, and Vermont have no large or medium hubs.

As part of airport inspections, the FAA updates the Airport Master Records for public-use airports, and reports the results as part of the Airport Safety Data Program. Runway pavement condition is classified as good (all cracks and joints sealed), fair (mild surface cracking, unsealed joints, and slab edge spalling), or poor (large open cracks, surface and edge spalling, vegetation growing through cracks and joints). Data for 1997 indicate that, nationwide, 72 percent of runways at NPIAS airports are rated good, 23 percent are fair, and 5 percent are poor. Pavement at commercial service airports is much better than average, with 79 percent good, 19 percent fair, and 2 percent poor. Poor runways at commercial service airports are not used by large aircraft. They are usually short runways that are occasionally used by light aircraft to avoid crosswinds. Runways with potentially hazardous pavement deficiencies are temporarily closed by management pending resolution and repair.

The pavement conditions are improved over 1986, when runways at commercial service airports were rated 78 percent good, 15 percent fair, and 7 percent poor**.** Comparisons between two sets of observations made 11 years apart are not always reliable, but in this case a large number of observations were taken**.** Because the rules for classification are straightforward and a similar trend was reported in 1990 and 1993, it is believed that the reported improvement is accurate. In comparison, 39 percent of arterial highway pavement and 50 percent of interstate highway pavement is reported to be in good condition. The favorable report on runway condition is a credit to the thousands of state and local agencies that operate airports.

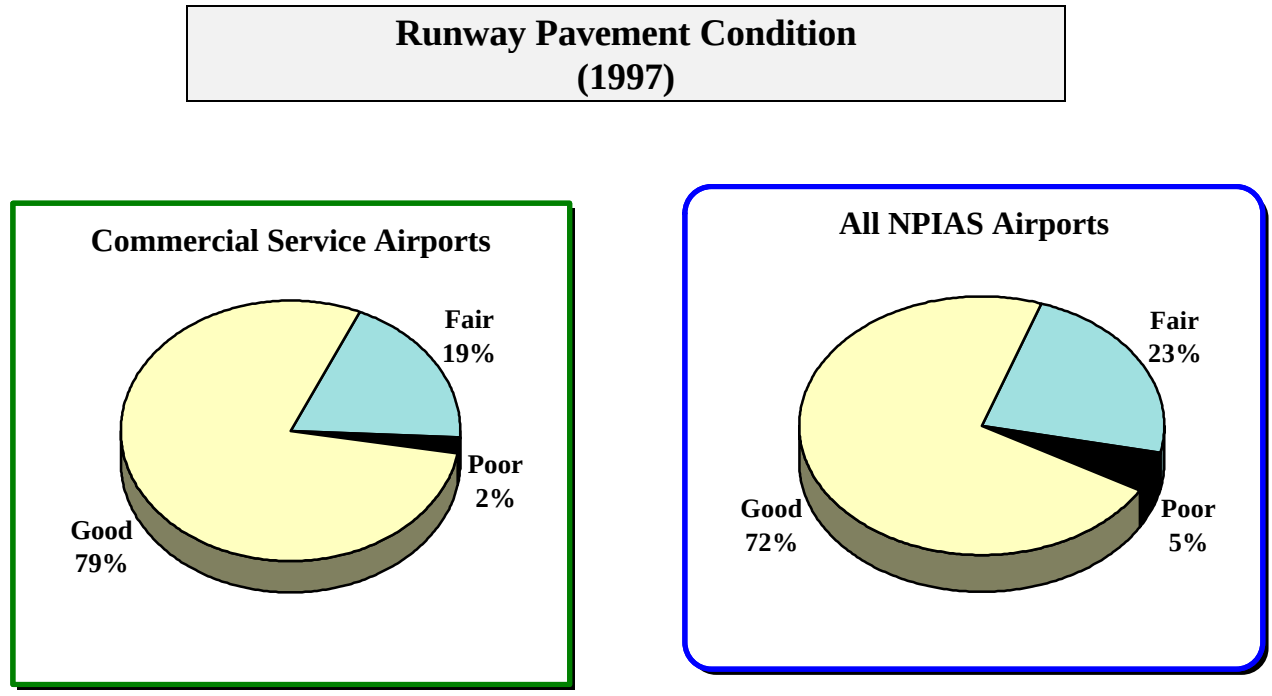


Figure 8 Runway Pavement Condition (1997)

In July 1998 the General Accounting Office (GAO) completed a report on runway conditions at national system airports. The GAO collected data on runway pavement condition from about 35 percent of airports eligible for Federal funding and determined that approximately 88 percent of the runways in the sample were in fair or better than fair condition.

ACCESSIBILITY

Airports have been planned to make air transportation as convenient and accessible as possible. A review of the 1990 census reveals that most Americans reside within 20 miles of a NPIAS airport (20 miles is a surrogate for 30 minutes ground travel time). Primary and commercial service airports are within 20 miles of 70 percent of the population (79 percent when reliever airports are included). When general aviation airports are also included, 98 percent of the population is within 20 miles of a NPIAS airport.

Population Within 20 Miles of a NPIAS Airport

Airport Categories	Percentage of U.S. Population
Primary and other Commercial Service	70
Primary, Other Commercial Service, & Reliever	79
All NPIAS Airports	98

Table 4 Population within 20 Miles of a NPIAS Airport

However, geographic proximity alone does not ensure that airports are conveniently accessible. Highway congestion in metropolitan areas can seriously impede ground access. Many cities are considering expanded use of public transportation to improve the convenience and reliability of airport access and to enhance air quality.

Ridership statistics for existing transit linkages to major airports indicate an important, but distinctly limited, role for metropolitan rail systems. The most successful linkage is to Ronald Reagan Washington National Airport (DCA) via the modern and extensive Metrorail system. Transit has accounted for about 15 percent of trips to DCA and may reach 20 percent because the new terminal provides convenient access to transit. The next best performers are Atlanta's MARTA rail link to Hartsfield Airport, with a 9 percent market share, and Boston's MBTA rail link to Logan Airport, with a 7.5 percent market share. Transit links to Chicago O'Hare, New York JFK International, Philadelphia International, and Cleveland Hopkins Airports all account for between 3 percent and 4 percent of airport access trips.

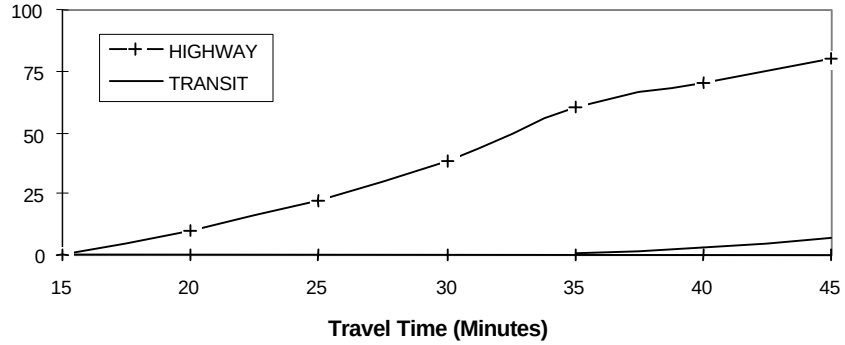
Experience to date suggests that public transportation (bus, rail, etc.) usually will not attract more than 30 percent of ground access trips to major airports. The same appears to be true in Europe, where higher market shares are achieved only by linkages to extensive national rail systems that connect to cities beyond the metropolitan area served by the airport.

The immense difficulty of shifting airport access from highway to transit is illustrated by charts showing the percentage of passenger origins and destinations within various travel times of selected airports. Highway coverage is very good, with 70 percent to 90 percent of passengers within 45 minutes of the airport during peak travel periods. Transit coverage is poor, with less than 10 percent of travelers able to reach the Baltimore or Minneapolis airports in 45 minutes. Even in Boston, where the airport is linked to an extensive metropolitan rail system, only 25 percent of passengers can reach the airport within 45 minutes, and no more than 40 percent of passengers can reach the airport by transit, even if they allow 90 minutes for the trip**.** Because highway access is more convenient for most travelers, it accounts for most trips to airports.

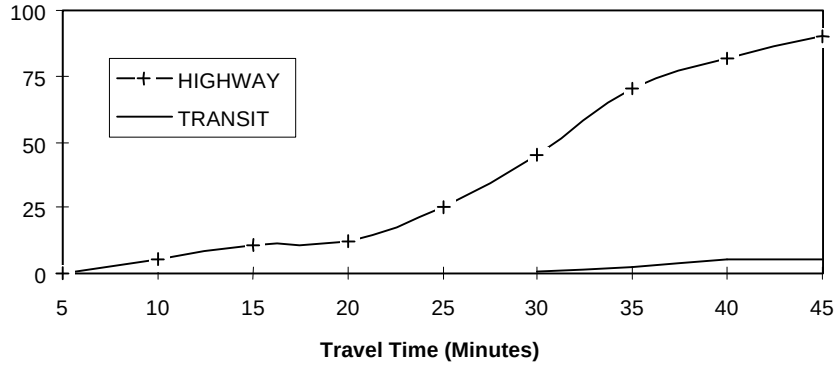
In encouraging appropriate solutions to ground access problems, the Department of Transportation advocates a multimodal approach that is the most efficient and convenient to the public. The Department promotes an airport ground access planning process that is consistent with surface transportation planning processes conducted under the Intermodal Surface Transportation Efficiency Act. To be effective, the planning of ground access improvements for busy airports must address a number of issues. Some of these are primarily the concern of airport operators, such as the need to expand airport capacity, improve accessibility, and minimize environmental damage to neighboring communities. Others are of primary concern to those responsible for transportation planning at both the State and local levels, or are driven by various Federal laws and regulations. The Federal Highway Administration and Federal Aviation Administration jointly issued a report entitled Intermodal Ground Access to Airports: A Planning Guide, dated December 1996, to help transportation planners achieve efficient ground access systems. The document is designed to assist local and Metropolitan Planning Organization planners in conducting analyses of airport access improvements in a manner that is consistent with the planning process and used for statewide and metropolitan area transportation management systems.

Accessibility of Selected Airports

MINNEAPOLIS



BALTIMORE



BOSTON

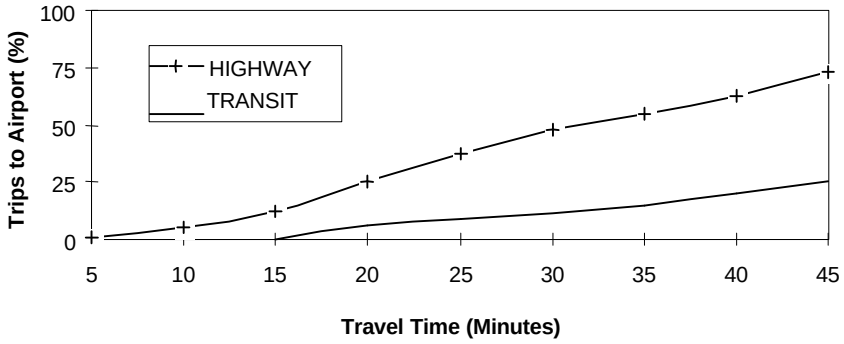


Figure 9 Accessibility of Selected Airports

FINANCIAL PERFORMANCE

An understanding of airport finance is an essential basis for national aviation policy. Airports account for approximately 9 percent of all spending on air transportation[1]. However, since airports are owned and operated by thousands of state and local agencies, it is difficult to compile comprehensive data on their financial operations. It is also difficult to state the precise amount of public spending on development, operations, or maintenance for the airport system because the sources of information on airport income and expenses are limited.

In 1996, pursuant to section 111 of the Federal Aviation Administration Authorization Act of 1994, airports were required to begin filing two financial reports with the U.S. Department of Transportation. One financial report requires sponsors of federally assisted airports to report the amounts paid and services provided to other units of government. The other financial report requires sponsors of commercial service airports to report in detail the total revenue and expenditures at the airport, including revenue surplus. Financial reports are due to the FAA 120 days after an airport's fiscal year ends.

Reports were received from 472 airports for fiscal years ending in 1997. These airports reported total non-operating revenues of $6.8 billion, including $3.9 billion from bond proceeds, $0.1 billion from the sale of property, $0.9 billion from grants, $1.2 billion from passenger facility charges, and $0.7 billion from other non-operating sources, including interest. It is noted that the bond proceeds included both new issues and an unspecified amount of reissues of existing debt.

In an effort to gather information regarding airport income and expenditure, the American Association of Airport Executives (AAAE) conducted a survey of NPIAS airports. The statistics, presented in Tables 5 and 6, were estimated from the results of 196 completed survey responses and were based on 1992 data. AAAE began updating airport income and expenditure data in 1998 but had not completed its work at the time this report was being prepared. Approximately 81 percent of the large, medium, and small hub airports completed and returned the 1992 survey. The survey results were compared to published annual reports of 65 large, medium, and small hub airports. The FAA found a close agreement between the survey and the annual reports.

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[1] Based on 1992 air carrier passenger revenues of $60.5 billion, air carrier cargo revenues of $9.0 billion, general aviation aircraft purchases and operating costs of $9.8 billion (all net of user taxes and airport fees), Aviation Trust Fund income of $7.8 billion (net of grants to airports), and airport income of $8.9 billion (net of non-aeronautical income). This is the latest data available.

The tables identify major income sources and expenditures and show considerable variation among airport categories. For instance, concession revenues are a very significant source of income for large hub airports, but are a much smaller part of the income of general aviation airports. Expenditures exceed income for most categories of airports largely because in a few instances the table includes construction cost rather than annual debt service under capital costs, and depreciation was included as an operating cost for some airports. Detailed information on Federal grants can be obtained from the FAA's annual reports.

The tables also indicate that the largest airports are relatively self-sustaining, receiving between 10 and 20 percent of their budget from the Federal grants, while the vast majority of small airports look to Federal grants to pay as much as one half of their budget. Large and medium hubs generally have excellent credit ratings and often borrow funds to accomplish some portion of needed development. However, these airports may face constraints, such as restrictions in use agreements, bond documents, and local ordinances, which can limit access to bond financing. Further, the pressure to remain cost competitive with other airports may limit the amount of borrowing an airport elects to undertake with revenue bonds. Smaller airports have limited incomes and generally do not have adequate operating surpluses to repay borrowed funds. As a result, small airports tend to rely heavily on grants to finance capital improvements.

1992 Estimated Airport Expenditures (Millions)

Category	Number of Airports	Capital	Operation & Maintenance	Total	Average Per Airport
Large Hub	29	$3,346.7	$2,357.3	$5,704.0	$196.7
Medium Hub	39	$750.1	$754.6	$1,504.7	$38.6
Small Hub	79	$609.1	$389.4	$998.5	$12.6
Nonhub	262	$442.7	$329.3	$772.0	$2.9
Other Commercial Service	120	$339.4	$99.1	$438.5	$3.7
Reliever	284	$399.7	$169.4	$569.1	$2.0
General Aviation	2,648	$201.1	$250.4	$451.5	$0.2
Total	3,461	$6,088.8	$4,349.5	$10,438.3	

Table 5 Estimated Airport Expenditures (1992)

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1992 Estimated Airport Income
(Millions)

Category	Number Airports	Concessions	Air Carrier	Cargo	Fixed Base Operator	General Aviation	Estimated Grants	Actual Grants	Other (Includes PFC)	Total	Average Per Airport
Large Hub	29	$1,599.5	$2,274.0	$93.9	$34.3	$36.0	$399	($457)	$613.9	$5,051.0	$174.2
Medium Hub	39	$515.5	$675.7	$53.1	$17.8	$16.3	$273	($306)	$127.9	$1,679.5	$43.1
Small Hub	79	$170.0	$251.1	$22.7	$13.2	$20.0	$297	($206)	$119.0	$893.1	$11.3
Nonhub	262	$89.5	$75.6	$0.1	$147.6	$90.4	$221	($235)	$80.7	$704.7	$2.7
Commercial Service	120	$8.1	$16.5	$0.0	$26.0	$11.6	$207	($56)	$23.2	$292.8	$2.4
Reliever	284	$39.5	$0.0	$0.0	$44.7	$113.2	$258	($165)	$62.9	$517.9	$1.8
General Aviation	2,648	$9.7	$85.3	$0.0	$39.2	$101.0	$229	($252)	$72.2	$536.1	$0.2
Total	3,461	$2,431.8	$3,378.2	$169.8	$322.8	$388.5	$1,884	($1,677)	$1,099.8	$9,675.1	

Table 6 Estimated Airport Income (1992)

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CHAPTER 3

ACTIVITY FORECASTS

OVERVIEW

Increased demand for air transportation will significantly affect the future pattern of capital investment in airports. Gradual growth in domestic air travel and more rapid growth in international travel will lead to a steady stream of projects to expand passenger facilities. Major airlines will probably continue using large transfer hubs, but few if any major new hubs are expected.

ACTIVITY FORECASTS

The early 1990's were a period of slow growth and financial difficulty for the aviation industry, due to the lethargy of the U.S. and world economies. U.S. commercial air carrier enplanements increased at an annual rate of less than 1 percent from 1990 through 1993, and the carriers recorded operating losses totaling close to $5 billion. However, between 1994 and 1997, passenger enplanements by 85 U.S. commercial air carriers reporting data to the Department of Transportation grew at an annual rate of 6.2 percent and reported cumulative operating profits of over $21 billion. In 1997, these commercial air carriers set records for a single year's financial performance with operating profits of almost $8 billion. The larger U.S. airlines were active in foreign markets, where their efficiency made them extremely competitive. Regional/commuter passenger traffic will continue to grow at a faster rate than their larger domestic counterparts. The continued integration of a large number of high-speed turboprops and regional jets by the regional/commuter airlines is expected to stimulate activity at nontraditional regional/commuter markets. In 1995 and 1996 the active general aviation fleet increased.[1]

The FAA's forecasts through 2009 are based on an improvement of the economic situation, with the U.S. economy expected to grow at a moderate annual rate of 2.3 percent, while the worldwide economy grows at a more rapid rate of 3.4 percent, including a particularly rapid rate of 4.6 percent in Latin American and the Far East/Pacific Basin countries. Inflation is expected to remain in the low to moderate range, barring any major disruption in the price and availability of oil. New activity forecasts, to be issued by the FAA's Office of Policy and Plans in 1999, will address the economic downturn which occurred in the Far East and Pacific Basin countries in 1998.

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[1] Source: FAA Aviation Forecasts FY 1998-2009 issued in March 1998.

Domestic air carrier enplanements are forecast to increase at a 3.5-percent rate annually through 2009 and international enplanements to increase by 5.8 percent, for a system average annual growth of 3.7 percent in enplanements. Air carrier aircraft operations will grow at a slower rate of 2.3 percent annually because of the use of larger aircraft. Regional/commuter enplanements are expected to increase at 5.5 percent annually and aircraft operations at 2.1 percent. General aviation operations are forecast to increase at a rate of 1 percent annually.

Aviation Activity Forecasts

Aviation Activity	1997	2009	Annual Growth (%)
Enplanements (Millions)			
✈ Domestic	542.3	821.5	3.5
✈ International	52.5	102.8	5.8
✈ Atlantic	16.5	27.8	4.4
✈ Latin America	20.2	41.5	6.2
✈ Pacific	15.8	33.5	6.5
✈ System (Domestic & Int'l)	594.7	924.3	3.7
✈ Commuter/Regional	61.9	117.0	5.5
Aircraft Operations (Millions)			
✈ Air Carrier	14.2	18.6	2.3
✈ Commuter/Regional	10.0	12.8	2.1
✈ General Aviation	36.6	41.5	1.0
✈ Military	2.5	2.5	-0.2
✈ Total	63.4	75.4	1.5

Table 7 Aviation Activity Forecasts

IMPLICATIONS OF FORECASTS

The forecast for a 62-percent increase in passenger enplanements between 1997 and 2009 suggests that a major investment will be needed to expand terminals to accommodate more passengers and larger aircraft. The technology used in future terminals will be similar to current designs in many respects, although a major increase is likely in the use of automated people movers to expedite pedestrian traffic around large terminal complexes. Also, new terminal designs are more likely to incorporate public transit, particularly in cities with well-developed transit systems.

The trend toward the use of midfield terminals at airline transfer hubs will continue. Midfield terminals are key features at Atlanta and Pittsburgh and the new Denver airport, and similar developments are underway at Detroit Metropolitan and Washington Dulles. Unlike most terminals, which have automobile parking on one side and aircraft parking on the other, midfield terminals are surrounded by parked aircraft, maximizing the opportunities for efficient passenger transfers. Access to ground transportation is usually provided by an underground automated people mover.

Another feature of transfer hubs is the use of automated baggage handling equipment to speed the transfer of baggage between flights. It is difficult to accommodate automated baggage handling equipment in existing buildings, but it is being incorporated into new terminals at transfer hubs, where the structure can be designed specifically to accommodate it.

The 62-percent increase in passengers is expected to be accomplished by a 32-percent increase in air carrier aircraft operations. Over the next decade, the FAA anticipates that the average seating capacity of air carrier aircraft will increase by approximately 2 seats per year. In addition, aircraft utilization is expected to continue to increase as more carriers seek to reduce gate turn-around times. Load factors are also expected to remain at current historical high levels. The implications of the increase in air carrier aircraft operations will vary, depending on activity levels at individual airports. The growth will present little problem for most low activity airports, which have unused runway capacity. The increase in air carrier operations at medium hubs will be accommodated by scheduling more flights for off-peak periods, attracting a portion of general aviation activity to reliever airports, and developing new runways to increase airfield capacity.

A substantial increase in aircraft operations at a large hub airport may warrant consideration of additional runways. The prospects for new runway construction are better at airline transfer hubs than at the older and more congested origin/destination airports serving major metropolitan areas. Most transfer hubs have new runways planned or under consideration. Airlines selected these airports as hubs in part because of their potential for expansion, and airport management is eager to provide adequate runway capacity in order to ensure that the airlines continue to operate there, rather than switching hub operations to a competing airport. Much of the additional capacity at transfer hubs is intended for use by commuter and regional airline aircraft, which transport passengers from smaller cities within several hundred miles of the hub. This traffic is expected to grow as regional carriers acquire jet aircraft to supplement their propeller driven fleet.

The outlook for new runways at major origin/destination airports is less promising. A few large hub airports where more than two-thirds of traffic is locally generated are actively considering new runways**.** The engineering and political obstacles to new runway construction at these airports are daunting. The strategy for reducing delay at most of the congested origin/destination airports is likely to include regulatory and administrative efforts to encourage the use of larger aircraft and to maximize schedule

efficiency, filling in any off-peak periods, and distributing traffic to supplementary air carrier airports. Airfield congestion at major origin/destination airports is and will continue to be one of the most difficult issues facing civil aviation.

OTHER FACTORS

The requirement for airports is affected not only by the volume of air transportation but also by the way in which it is provided. Airlines are expected to continue to concentrate their schedules at busy transfer hubs, where large numbers of flights converge in short periods of time to maximize the opportunity for passenger transfers. The current number of hubs appears to be adequate to meet airline requirements. No additional hubs are expected within the next 5 years. Increased direct service, bypassing hubs, is likely when warranted by airline marketing considerations. Parallel runways are planned at some transfer hubs to accommodate operations by regional airlines, which are being used to connect to smaller cities.

Lower cost carriers are likely to serve major metropolitan areas, possibly initiating service to uncongested, secondary commercial service airports where existing facilities are underutilized. In some cases, however, service has been initiated at major airports. For example, low cost carriers presently operate at the major airports in Phoenix, Saint Louis, and Salt Lake City. In these cases, secondary commercial service airports are not available.

The globalization of the airline industry, rapid growth of air transportation overseas, and the increased range of aircraft will combine to bring more international passengers to more U.S. airports. The effects will vary but may include requirements for longer runways, terminal building expansion, and provision of Federal inspection facilities for immigration, customs, and agriculture at airports where international traffic is increasing.

The increased number of turboprop and jet aircraft in the general aviation fleet will result in a demand for longer runways at certain reliever and general aviation airports, particularly those used by business and corporate aircraft.

CARGO

Air cargo is very important to the U.S. economy, as illustrated by U.S. Department of Commerce statistics that 28 percent of exports and 18 percent of imports by value in 1990 were shipped by air. Air transportation is a preferred mode for the shipment of high value, lightweight, and perishable goods.

Air cargo is concentrated at busy commercial service airports and much of it is carried in the baggage compartments of scheduled passenger aircraft. Less than 5 percent of scheduled flights are by all-cargo aircraft, and these are usually derivatives of passenger

aircraft. Cargo flights usually occur during off-peak periods and do not substantially contribute to airport congestion and delay problems.

The principal need for airport development is related to the cargo sorting and transfer facilities developed by small-package, express carriers. These facilities are concentrated in a geographic area around the Ohio River Valley where flights can be brought together efficiently to transfer cargo. These airports must have high capacity, all-weather runway systems to support reliable operations. Improvements may also be warranted at selected airports, such as JFK, O'Hare, Miami, Anchorage**,** and Los Angeles International, to keep pace with rapid growth in international air cargo.

INNOVATIONS

Efforts are underway to develop transportation and communication technology that may eventually affect the demand for conventional air transportation. Prototypes of tiltrotor aircraft may evolve into effective vehicles for air travel between city centers or suburban areas, bypassing congested airports. High-speed trains are being demonstrated that could attract more passengers to rail in specific markets, and research is underway into magnetic levitation (maglev) vehicles. Teleconferencing and other electronic communication techniques could affect the demand for business travel. These innovations may eventually have a significant effect on airport development needs, but this is not expected to occur during the next 5 years, which is the period addressed by this report.

CONVERSION OF SURPLUS AIRFIELDS

About 33 surplus military airfields are being converted to civil use. Some, notably Myrtle Beach AFB, Bergstrom AFB, and Agana Guam NAS, are ideally located to become commercial service airports. Other surplus airfields are located in areas where general aviation and reliever airports are needed.

AIR QUALITY

Improved air quality is an increasingly important consideration in transportation plans for urban areas. Many large cities must reduce vehicle emissions substantially in order to meet the requirements of the Clean Air Act Amendments of 1990. The FAA must determine that projects receiving Federal aid under the Airport Improvement Program conform to applicable State Implementation Plans, which often call for large reductions in emissions.

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CHAPTER 4

DEVELOPMENT REQUIREMENTS

OVERVIEW

Information on the development needed to provide an adequate national system of airports is derived primarily from locally prepared airport master plans and regional and state system plans. Although these plans are not yet subject to uniform cost/benefit analysis, their development recommendations are tied to the current use and condition of each airport and the forecast increase in activity. Costs are categorized by type of airport and by purpose of development: Safety and Security, Reconstruction, Standards, Environment, Airfield Capacity, Terminal Buildings, Ground Access, and New Airports. These development costs are shown on Table 8. For comparison purposes, a table (Table 9) is provided showing development requirements contained in the previous edition of the NPIAS. Because the NPIAS is an aggregation of airport capital projects identified through the local planning process, rather than a spending plan, no attempt is made to prioritize the development projects that comprise the database or evaluate whether the benefits of specific development projects would exceed the costs.

PROCESS

The principal data sources for the NPIAS are airport master plans prepared for airport owners by consulting firms. These plans are reviewed and approved by FAA field offices. They follow a standard outline contained in an FAA advisory circular that links development to current and forecast activity. The plans include consideration of all significant aviation requirements, including the needs of national defense and the postal service. Plans for major development, such as new runways or runway extensions, tend to be controversial and the planning process provides interested parties with the opportunity to request a public hearing. Proposed development items that are either not justified by the forecast of aviation activity, such as additional runways, or ineligible for Federal funding, such as hangars, are screened by FAA planners and are not entered into the NPIAS database. The combination of a planning process that links development to activity, an FAA review that culls out unnecessary and ineligible development, and the discussion of controversial proposals at public hearings results in reasonable and well-documented estimates of future airport development requirements. However, the actual timing and cost of development may vary from airport master plans. For instance, projects may be deferred or developed in stages in order to reduce immediate costs, or conversely, an unexpected rapid increase in activity may justify accelerating certain development.

Airports and airlines frequently engage in discussions regarding major airport investment programs. Airlines have questioned the scope and timing of specific development proposals, including major new airports, ground access projects, and certain terminal and airfield improvements. The NPIAS generally reflects the airport operator's viewpoint regarding the scope and schedule for proposed development. If proposals are downsized, rescheduled, or accomplished in stages, development costs could be significantly lower. The total cost of development in the report is 18 percent higher than the preceding report, issued in 1995. This increase appears to be largely due to an increase in the airport development program at the large hubs.

ADDITIONAL COSTS NOT INCLUDED IN THE NPIAS

The NPIAS only includes development that is eligible to receive Federal grants under the Airport Improvement Program. It does not include ineligible airport development, such as automobile parking structures, hangars, air cargo buildings, or the revenue-producing portion of large passenger terminal buildings. It does not include development eligible under the passenger facility charge program but ineligible under the Federal grant program, such as gates and related areas. Neither does it include improvements to highway and transit systems beyond the airport property line, even though some improvements that are for airport access and on property owned or effectively controlled by the airport sponsor may be eligible for AIP funds. There is no precise estimate of airport access requirements, but they are known to be substantial.

The NPIAS is drawn from approved plans and may not include some emerging requirements related to new large aircraft and enhanced security measures, for which cost estimates have yet to be formulated. The NPIAS only includes development to be undertaken by airport operators and does not include improvements to air traffic control and navigation and approach aids that are funded entirely by the FAA.

The NPIAS also does not include development needed to relieve airfield congestion in metropolitan areas when there is no local consensus about how to relieve the problem.

RANGE OF OPINIONS

There is an ongoing debate about the amount of capital investment required at airports. Authoritative estimates in 1997 ranged from a high of $10 billion annually by the Airports Council International (ACI) to a low of $4 billion annually by the Air Transport Association (ATA).

The General Accounting Office (GAO) has reviewed these various estimates and compared them to the NPIAS. GAO concluded that the differences are primarily due to different assumptions about which types of airports and development to include.

When comparable assumptions were applied, the differences among estimates were substantially reduced.

The ACI estimate of $10 billion annually includes both AIP-eligible and -ineligible projects, regardless of their relative priority, and an allowance for 3-percent annual cost inflation. The ATA estimate only includes AIP-eligible development for projects at primary airports, and makes no provision for inflation. When these estimates were normalized and compared to the NPIAS, a reasonably close agreement was achieved.

Similarly, Coopers and Lybrand reviewed the issue of airport capital investment. It predicted that the average annual spending on airport capital improvements would be in the range of $7 billion to $8 billion per year for the years 1997-2002. This includes both AIP-eligible and -ineligible development.

The FAA has considered the range of opinion, and believes that the NPIAS provides an accurate indicator of the airport development that is eligible for AIP and warranted to meet the current and forecast demand for air transportation.

DEVELOPMENT CATEGORIES

The total $35.1 billion in the NPIAS is divided into categories on the basis of the principal purpose of development.

SAFETY AND SECURITY

Safety and security projects include development that is required by Federal regulation, certification procedure, or design standard, and intended primarily for the protection of human life. This category, which accounts for 3.1 percent of the NPIAS, includes obstruction lighting and removal, fire and rescue equipment, fencing, and security devices. This type of development is given the highest priority by the FAA in order to ensure its speedy implementation and achieve the highest possible level of safety and security.

RECONSTRUCTION

Reconstruction includes development to replace or rehabilitate airport facilities, primarily pavement and lighting systems that have deteriorated due to weather or use and reached the end of their useful lives. This category, which accounts for 11.6 percent of NPIAS costs, includes the rehabilitation of pavement on a 15- to 20-year cycle. Failure to replace deteriorating pavement increases airport maintenance costs and can result in damage to propellers and engines, pooling of water and ice deposits, and eventually potholes that can damage landing gear. Airfield lighting cables and fixtures deteriorate with age, resulting in dim and unreliable lighting if they are not replaced.

Reconstruction is included in the NPIAS when normal maintenance procedures are no longer economical and effective.

STANDARDS

Standards projects include development to bring existing airports up to design criteria recommended by the FAA**.** This is the largest development category, accounting for 37 percent of the NPIAS, up from 21 percent in the 1993 report. This is due largely to a change in how the FAA classifies certain types of development. FAA now classifies apron expansion, taxiway construction, and other development to accommodate additional aircraft at uncongested airports as standards rather than capacity, as it was in the past.

Many commercial service airports were designed up to 50 years ago to serve relatively small and slow aircraft, but are now being used by larger and faster turboprop and jet aircraft. As a result, runways and taxiways must be relocated to provide greater clearance for aircraft with long wing spans, and aircraft parking areas must be adapted to accommodate larger aircraft. Standards development at general aviation and reliever airports is generally justified to accommodate a substantial number of operations by "critical" aircraft with sizes and operating characteristics that were not foreseen at the time of original construction. If it is not undertaken, aircraft may be required to limit fuel or passenger loads because of inadequate runway length. The FAA usually requires an indication that an aircraft type will account for at least 500 annual itinerant operations at an airport before development is included in the NPIAS to accommodate it.

ENVIRONMENT

Environment includes development to achieve an acceptable balance between airport operational requirements and the expectations of residents of the surrounding area for a quiet and wholesome environment. This development supplements the large noise reductions that are being achieved by quieter aircraft and the use of noise abatement procedures. It accounts for 5 percent of NPIAS costs and includes the relocation of households and soundproofing of residences and public buildings in areas underlying aircraft approach and departure paths. Most of the cost is for land acquisition in fee simple or easements to compensate property owners for overflights. Environmental costs are concentrated at airports with frequent flights by jet aircraft (43 percent large hubs, 29 percent medium hubs, 16 percent small hubs, 5 percent nonhubs, and 6 percent reliever airports). This development is part of an extensive Federal and industry program, involving land use planning, quieter aircraft, and noise abatement procedures, that has reduced the estimated number of people exposed to significant noise by approximately 75 percent since 1975 (see figure 7 on page 18).

TERMINAL BUILDING

Terminal building costs are incurred for development to accommodate more passengers and more or larger aircraft. This category has increased in recent years and now accounts for 16 percent of the NPIAS. The NPIAS only includes the portion of terminals at large airports that is eligible for Federal aid (about 50 to 60 percent) and excludes revenue generating areas used exclusively by a single tenant or concessions, such as gift shops and restaurants. The development is concentrated at the busiest commercial service airports (94 percent large hubs, 3 percent medium hubs, 2 percent small hubs, and 1 percent nonhubs).

ACCESS

Access includes the portion of airport ground access (highways and transit) that is within the airport property line and eligible for grants under the Airport Improvement Program. It currently accounts for 12 percent of the NPIAS.

AIRFIELD CAPACITY

Airfield capacity is the development necessary to accommodate more and larger aircraft operations on runways and taxiway systems at airports experiencing or expecting to experience 20,000 hours of delay or more. This accounts for 13 percent of the NPIAS, down from 31 percent in the 1993 NPIAS. This decrease is due to the change in how the FAA classifies certain types of development. The category was broader in 1993 and included development to accommodate additional aircraft at airports where runway congestion was not a severe problem.

Runway development that is warranted to relieve congestion but precluded because of political and environmental considerations is not included. The airfield capacity development included in this 5-year plan will help to control congestion at many busy airports. However, severe problems will remain in certain large metropolitan areas like New York, and the FAA will continue to focus on the need for additional capacity at those locations.

NEW AIRPORTS

New airports are recommended in the NPIAS for communities that generate a substantial demand for air transportation and either do not have an airport or have an airport that cannot be improved to meet minimum standards of safety and efficiency. In addition, new commercial service and reliever airports are recommended for communities where existing airports are congested and cannot be expanded to meet the forecast demand for air transportation. Few major new airports are foreseen during the next 5 years but a number of new reliever and general aviation airports are proposed.

The new airport category includes most of the anticipated cost of converting surplus military airfields to civil use.

ANTICIPATED SOURCES OF FUNDING

There are generally five resources used to finance airport development: airport cash flow, revenue and general obligation bonds, Airport Improvement Program grants, passenger facility charges, and state and local grants. Access to these sources of financing varies widely among airports, with some large airports maintaining substantial cash reserves while the small commercial service and general aviation airports often require subsidies from local and state governments to fund operating expenses and finance modest improvements.

Historically the combined resources have been adequate to achieve needed development. Funding varies from year to year, but it has been in the range of $5.5 billion to $7.3 billion since 1990. This represents total public spending, including projects eligible for AIP grants (NPIAS) and projects ineligible for AIP grants like automobile parking garages and hangars. Discussions with representatives of airports, airlines, and the investment community lead the FAA to believe that this combination of resources should continue to be adequate for the foreseeable future.

Smaller airports are expected to continue to be very dependent on Federal, state, and local grants to achieve capital improvements. The largest airports are less dependent on grants and exhibit an increasing ability to operate as freestanding financial entities.

1998-2002 NPIAS Cost by Airport And Development Category ($ Thousand)

Category	Safety & Security	Recon-struction	Standards	Environment	Capacity	Terminal	Access	New Airports	Total	%
Large Hub	204,840	727,715	4,419,654	803,124	2,866,631	5,333,324	3,367,722	0	17,723,009	50.5
Medium Hub	131,892	749,214	1,455,106	535,513	986,567	162,221	695,312	0	4,715,823	13.4
Small Hub	119,478	423,430	1,515,108	298,943	379,225	105,681	111,008	0	2,952,873	8.4
Nonhub	294,053	675,995	1,448,900	73,968	167,911	53,020	85,504	36,667	2,836019	8.1
Commercial Service	42,130	170,224	191,670	11,081	45,723	3,124	7,179	0	471,111	1.3
Reliever	98,677	459,402	1,327,415	120,701	81,025	1,400	53,808	214,433	2,356,862	6.7
GA	196,634	871,020	2,497,997	18,184	167,375	8,303	62,847	215,104	4,037,464	11.5
Total	1,087,702	4,077,000	12,855,850	1,861,494	4,694,456	5,667,073	4,383,380	466,204	35,093,160	
Percentage	3.1	11.6	36.6	5.3	13.4	16.1	12.5	1.3		

Table 8 NPIAS Cost by Airport and Development Category (1998-2002)

1993-1997 NPIAS Cost by Airport And Development Category ($ Thousand)

Category	Safety & Security	Recon-struction	Standards	Environment	Capacity	Terminal	Access	New Airports	Total	%
Large Hub	79,561	918,840	536,624	938,356	4,576,198	3,329,552	394,119	2,254,221	13,027,471	43.8
Medium Hub	129,638	405,286	552,548	416,715	1,613,220	396,551	90,203	158,989	3,763,150	12.7
Small Hub	329,936	395,546	767,575	322,268	1,080,355	305,883	93,029	0	3,294,592	11.1
Nonhub	168,008	555,862	1,014,599	35,252	530,733	253,446	90,542	9,641	2,658,083	8.9
Commercial Service	61,136	144,700	282,544	1,884	95,677	17,370	19,668	35,862	658,841	2.2
Reliever	78,142	305,030	895,239	27,949	752,165	24,209	41,469	352,308	2,476,511	8.3
GA	166,094	635,614	1,894,037	21,154	727,585	14,292	33,117	370,060	3,861,953	13.0
Total	1,012,515	3,360,878	5,943,166	1,763,578	9,375,933	4,341,303	762,147	3,181,081	29,740,601	
Percentage	3.4	11.3	20.0	5.9	31.5	14.6	2.6	10.7		

Table 9 NPIAS Cost by Airport and Development Category (1993-1997)

APPENDIX A
LIST OF NPIAS AIRPORTS WITH 5-YEAR FORECAST ACTIVITY AND DEVELOPMENT COST

Explanation of Terms and Abbreviations Used in the Appendix A

City - The city generally associated with the airport.

Airport - The official name of the airport or designated abbreviation.

Role - One of the five basic airport service levels which describe the type of service that the airport is expected to provide to the community at the end of the 5-year planning period. The service levels also represent funding categories for the distribution of Federal aid.

PR	Commercial Service - Primary
CM	Commercial Service - Nonprimary
CR	Commercial Service Airport that also serves as a reliever (included with CM in statistical summaries)
RL	Reliever Airport
GA	General Aviation Airport

Enpl - The number of revenue passengers expected to be boarded at the airport during the fifth year of the 5-year planning period.

Based Acft - The number of locally owned aircraft expected to be hangared or based at the airport at the end of the 5-year planning period.

Cost - The estimated 5-year costs for airport improvements that are eligible for Federal development grants under the Airport Improvement Program.

NOTE: The data presented in these tables were compiled as of January 1998. Current data for specific airports can be obtained from the appropriate regional office, as listed in Appendix C.

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APPENDIX B
STATE MAPS

Explanation of Maps in Appendix B

The maps contained in Appendix B show the location of existing airports contained in the National Plan of Integrated Airport Systems. Airports are usually identified by the name of the associated city. For cities with multiple airports, the airport name is shown. Icons are used to identify the airports as commercial service (primary and nonprimary), reliever, or general aviation.

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APPENDIX C
REGIONAL OFFICES' ADDRESSES AND TELEPHONE NUMBERS

NEW ENGLAND REGIONAL OFFICE

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut

Airports Division, ANE-600
Federal Aviation Administration
12 New England Executive Park
Burlington, Massachusetts 01803-5299
Telephone No.: (781) 238-7600
FAX: (781) 238-7608

EASTERN REGIONAL OFFICE

New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, and District of Columbia

Airports District, AEA-600
Federal Aviation Administration
Fitzgerald Federal Building, Room 329
John F. Kennedy International Airport
Jamaica, New York 11430
Telephone No.: (718) 553-3331
FAX: (718) 995-9219

SOUTHERN REGIONAL OFFICE

Georgia, North Carolina, South Carolina, Florida, Puerto Rico, Virgin Islands, Tennessee, Kentucky, Mississippi, and Alabama

Airports Division, ASO-600
Federal Aviation Administration
1701 Columbia Avenue
College Park, Georgia 30337
Telephone No.: (404) 305-6700
FAX: (404) 305-6730

MAIL ADDRESS:
Airports Division, ASO-600
Federal Aviation Administration
P. O. Box 20636
Atlanta, Georgia 30320

GREAT LAKES REGIONAL OFFICE

Illinois, Indiana, Michigan, Wisconsin, Minnesota, Ohio, North Dakota, and South Dakota

Airports Division, AGL-600
Federal Aviation Administration
2500 East Devon Avenue
Des Plaines, Illinois 60018
Telephone No.: (847) 294-7272
FAX: (847) 294-7036

CENTRAL REGIONAL OFFICE

Kansas, Missouri, Iowa, and Nebraska

Airports Division, ACE-600
Federal Aviation Administration
Federal Building
601 East 12th Street
Kansas City, Missouri 64106
Telephone No.: (816) 426-4698
FAX: (816) 426-3265

SOUTHWEST REGIONAL OFFICE

Arkansas, Texas, Oklahoma, New Mexico, and Louisiana

Airports Division, ASW-600
Federal Aviation Administration
2601 Meacham Boulevard
Fort Worth, Texas 76137-4298
Telephone No.: (817) 222-5600
FAX: (817) 222-5984

MAIL ADDRESS:
Department of Transportation, ASW-600
Federal Aviation Administration
Fort Worth, Texas 76193-0600

NORTHWEST MOUNTAIN REGIONAL OFFICE

Washington, Idaho, Oregon, Colorado, Wyoming, Utah, and Montana

Airports Division, ANM-600
Federal Aviation Administration
1601 Lind Avenue, S.W.
Renton, Washington 98055-4056
Telephone No.: (425) 227-2600
FAX: (425) 227-1600

WESTERN-PACIFIC REGIONAL OFFICE

California, Arizona, Nevada, Hawaii, American Samoa, Guam, and Commonwealth of Northern Marianas Islands

Airports Division, AWP-600
Federal Aviation Administration
15000 Aviation Boulevard
Lawndale, California 90261
Telephone No.: (310) 725-3600
FAX: (310) 536-8600

ALASKAN REGIONAL OFFICE

Alaska

Airports Division, AAL-600
Federal Aviation Administration
Anchorage Federal Office Building
222 West 7th Avenue, Box 14
Anchorage, Alaska 99513
Telephone No.: (907) 271-5438
FAX: (907) 271-2851